

Traditional Becomes Modern: the Rise of Collegiate Gothic Architecture at American Universities

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INTRODUCTION

In the late 19th and early 20th centuries American universities zealously embraced the architecture of Oxford and Cambridge as models for university life. This included both the enthusiastic building of housing for growing student populations, and the design of architectural features that mimicked stylistic components of the Gothic structures. Technological and sociological changes resulted in engineering and architectural changes in the planning and construction of new Gothic buildings in the United States. This paper will highlight both these changes and the challenges of dealing with the restoration of several examples of this building type. (**fig. 1**)



Figure 1. Princeton University: Blair (center, 1897), Foulke (left, 1923) and 1901/Laughlin (right, 1924)

The development of Collegiate Gothic buildings helped define the image of both Princeton and Yale. Subtle changes within that period represent evolving technological constraints and architectural ideas. In general, the construction of Collegiate Gothic buildings for the Princeton and Yale campuses used traditional, local materials such as brick, stone, and timber, yet also incorporated modern materials such as reinforced and unreinforced masonry, reinforced and plain

concrete, terra cotta, iron, steel, etc. In some cases, innovative materials such as gypsum studs and panels for partitions at stair enclosures were employed. Use of these more modern materials also allowed for more economical construction; less hand labor was required to complete these new Gothic buildings.

Success of these buildings can be measured, in part, by the fact that these are often the most desirable buildings in which to live, despite the fact that in many cases they have undergone only minimal updates over the years and are in somewhat worn condition.

Success is also measured by the ability of these buildings to be modified. During their renovations they have been able to withstand interventions while maintaining their structural and aesthetic integrity. At the same time they are capable of being updated with state-of-the-art systems and programmatic changes.

Both Princeton and Yale (as well as other schools) are in the process of renovating their stock of Collegiate Gothic residence halls. At Princeton and Yale this has involved taking each building/college off line for an academic year and the preceding/following summers (longer for some of the larger complexes) in order to do comprehensive renovations that will allow the buildings to serve the required functions without major work for the next 40-50 years. These projects typically include the following:

1. Conservation/restoration/rehabilitation of the building envelope and select interior spaces where retention of historic fabric is a goal,
2. Upgrading of mechanical, electrical, plumbing systems where existing systems typically have exceeded their useful lives. At both Princeton and Yale the original steam heating systems are inefficient and difficult to control. The universities are converting to hot-water based systems for heating as part of these projects.
3. Reconfiguration of the layout of these buildings to accommodate code requirements for egress, to allow for as much handicapped accessibility as is feasible, and to meet standards for modern living arrangements
4. Transformation of previously unfinished basement spaces into student social and recreational areas.

Given these requirements, the design team must understand the original construction not only as a way of best being able to preserve it, but also to be able to evaluate how best make design decisions that take into account the impact on the existing building. Having as complete an understanding as possible during the early design phase helps minimize unforeseen conditions during construction.

For this reason we typically review all available materials at the university planning offices and at university archives. We review original drawings, specifications, contemporary magazine articles, letters from architects, minutes of Trustees meetings, photographs, etc. To supplement this, the early efforts include on site surveys as well as destructive and nondestructive investigations to determine (or confirm) construction assemblies and conditions.

COLLEGIATE GOTHIC AT PRINCETON

During the late 19th Century, University President James McCosh ushered in an era of modernization, both in the curriculum and in the campus facilities. The growth of the campus to the south included a break from the axial arrangement of the existing campus and the inclusion of buildings that were not placed in formal relationship to one another. Styles varied throughout the 19th century, with Victorian architecture most prevalent towards the end of the century. Woodrow Wilson, at Princeton as a professor as of 1890, and President of the University beginning in 1902, advocated the reform of the curriculum, method of teaching and the plan of college life. His intent was to model a preceptorial system on the English model, with the hope that included with these changes would be the ability to inspire students and faculty.

The first collegiate Gothic buildings at Princeton were Blair Hall and Stafford Little Halls, both dormitories, by the architectural firm Cope and Stewardson. Their exteriors included battlements, pointed arches, leaded glass, bay windows, and decorative carvings. While Collegiate Gothic in style, in plan these buildings were informal in their meandering layout that responded to the topography and functional considerations such as creating an edge to the campus and an entry at the train station side of campus. The buildings themselves only loosely implied a sense of enclosure (such as might be found at a medieval cloister).

Ralph Adams Cram, hired as university architect in 1906, solidified the establishment of Collegiate Gothic as the style of choice, in part as an expression of his belief in the ideals of craftsmanship. For Cram, there was a moral rightness to the Gothic style that guided his design inspiration, yet the intent was to express the tradition of the Gothic, not necessarily with the same construction techniques. From the beginning, materials of the day were utilized in the building of Collegiate Gothic structures at Princeton.

The development of the Princeton campus was strongly influenced by Cram and his master plan of 1908. This plan attempted to restore some formal order by adding new buildings in relationship to the existing in a manner that created linked cloisters. The design of individual spaces, rather than following the rules of symmetry and axiality, followed more picturesque principles of narrowed and intensified vistas, unanticipated paths and quadrangles, and the revelation of the unexpected (Turner, p.233). Much of this plan was not executed, but the Collegiate Gothic flourished, particularly in residential buildings, into the 1930's. Overall, the buildings at Princeton, however,

did not programmatically coalesce into residential colleges until much later. For this reason, the linear, meandering style of building rather than the enclosed quadrangle, remains the dominant Princeton type. (fig. 2)



Figure 2. Cram's plan for Princeton, updated 1911

While in outward appearance there is a similarity to the various Collegiate Gothic buildings, the construction techniques used therein represent a progression out of the 19th Century traditions and gradually incorporate modern materials. The earliest of the Collegiate Gothic buildings at Princeton were constructed similarly to many of the Victorian dormitories on campus, such as Romanesque-inspired Witherspoon Hall. These included masonry bearing walls, wood floor and roof framing, wood windows, and slate roofs. It was the outward stylistic expression, with limestone carvings, arched passageways and picturesque towers and bays that created the Gothic appearance. The later Collegiate Gothic buildings, particularly those of Klauder and Day, utilized concrete construction and steel framing for elements such as floors and roofs. Windows began to be made of steel, with leaded glass lites. Interiors made use of hollow terra cotta tiles for non-loadbearing partitions as well as for insulation at exterior walls.

THE RENOVATION OF PATTON HALL

Patton Hall, designed by Benjamin Wistar Morris and constructed in 1906, was somewhat unique amongst the Collegiate Gothic buildings at Princeton. As one of the earlier Gothic buildings and as something that created the southern edge of campus at the time it was constructed, Patton's architecture included a richness of ornament and materiality that became less pronounced and more institutional on some of the later projects. (fig. 3)



Figure 3. Patton Hall's exterior is made of rock-faced schist with ornamental limestone trim

Patton was the first Collegiate Gothic dormitory to be renovated as part of Princeton's dormitory renewal program. The project began with the information gathering/programming phase in the summer of 1996, with construction completed in August of 1999.

Little documentation remained regarding the original construction of Patton. The drawings indicate that the building was originally called Ten Class Dormitory, for the alumni who donated funds for its construction. (fig. 4)

At Patton Hall it was through a series of investigations, some invasive, that some of the construction techniques and materials could be identified. Patton's exterior envelope consisted of solid stone bearing walls made of local mica schist laid in a random ashlar pattern, with window surrounds of

limestone, and a back-up stone of the local argillite that was used as a finish stone for many of the later buildings. Windows were wood casement windows. Roofing included clay tiles set on wood strapping over a wood structure. The very limited amount of steel in the building was used to help support the projecting limestone bays.

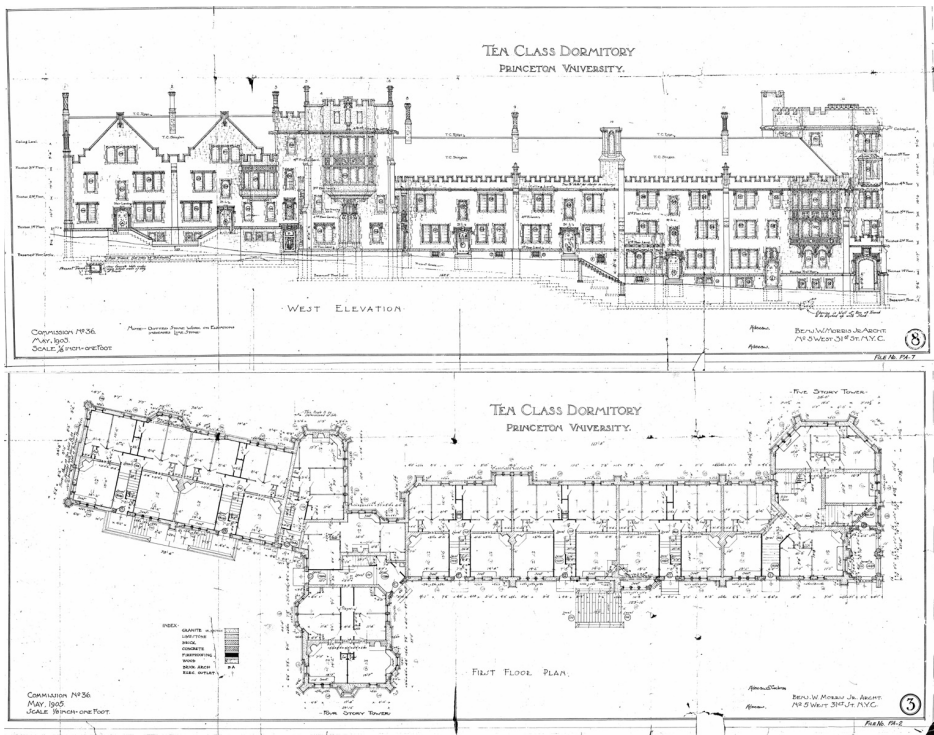


Figure 4. Original drawings of west elevation and 1st floor plan of Patton Hall

While the exterior stone was in very good condition, some exterior components were too worn to be retained, including the wood windows and clay roof tiles. The original wood windows (casements made of American Chestnut, with wood muntins rather than leaded glass) suffered due to weather, student use, and the local squirrel population. New windows, in addition to being sturdier due to deeper sections, were also made to accommodate a desire for additional thermal performance (with the addition of a tempered glass panel at the interior of the sash, routed into the wood sash frame) and the modern building code requirement for screens in residential buildings with the addition of wood-framed casement screens.

Interior structure included brick bearing walls and floor framing consisting of a combination of one-way concrete slabs without beams and two-way concrete slabs with beam construction. This is particularly significant since while reinforced concrete construction originated in Europe in the mid-

19th century, it was only beginning to be utilized in the United States in the early 20th century. The American Concrete Institute was founded in 1907, one year after the construction of Patton Hall, so it is reasonable to assume that the design parameters in effect at the time of construction relied on European experience.

Non-loadbearing wall construction typically included wood studs with wood furring and plaster. At stairwell walls and separations between suites, however, partitions were constructed with studs made of gypsum with a wood core. This product appears to have been something of a novelty. An early construction handbook identifies these as “Gypsinite Partitions” (Kidder, p.878). Under the sub-heading of Fireproofing of Building, these studs were described as follows:

The studs are carefully made and are plumb and true. Metal lath or plaster boards are secured to the studs and plastered, completing the partition, which is about 4 1/2” thick. This partition is slightly heavier than the ordinary partition of wooden construction. It is quite as stiff and as strong as a good tile or other partition, and the nailing strip feature of the studding facilitates the application of a wooden trim. It is said to be particularly sound-proof, and the spaces between the studs afford an opportunity to conceal pipes, wires, etc. Gypsinite studs are 3 by 3 by 12 in, and weigh 3 lb to the foot. They can be made any size required. In the partitions the studs are usually placed 16 in on centers and bridged as may be required. They are fastened to the floor or ceiling by the use of sills and plates of the same material, or by light channel irons, which are spiked to the fireproofing. The manufacturers believe that in large quantities these studs can be furnished as cheaply as wooden studs and that the partitions can be erected as cheaply as ordinary lath-and-plaster partitions. Gypsinite studs are manufactured by the United States Gypsum Company, Chicago, Ill.

At Patton these studs were covered with 1/2” gypsum sheets and 1/2” plaster. At some locations, where repairs had been made due to water infiltration problems (generally related to interior rain leaders) wire lath had been added prior to plaster repairs. (fig. 5)

As far as the original interior finishes were concerned, pine floors were split to the point that sanding and refinishing would not be satisfactory, so new oak flooring was added on top of the old. The remainder of the woodwork in the building was in sound condition and required only cleaning and refinishing. This included restoration of wood base moulding, window seats, fireplace mantles, and stair balusters. Where students had carved initials into wood mantles, this was retained as part of the history and character of the building.

Structurally, there was some concern as to whether or not the partitions below concrete beams might be contributing structurally. Where partitions were removed for architectural reasons, or where concrete beams were damaged prior to or during construction, reinforcing steel channels

were added to the existing concrete beams. There had also been some concern with the gypsum studs. For one thing, there was a need to identify the fact that the fire-resistance rating for this material is at least the equivalent of a 1-hour assembly, since the renovated building would need to comply with current building code requirements. Additionally, there was concern that these studs might not be structurally sound enough to withstand architectural modifications such as the need to secure handrails to them. In the end the studs were acceptable on both counts, and they remain as part of the building construction.

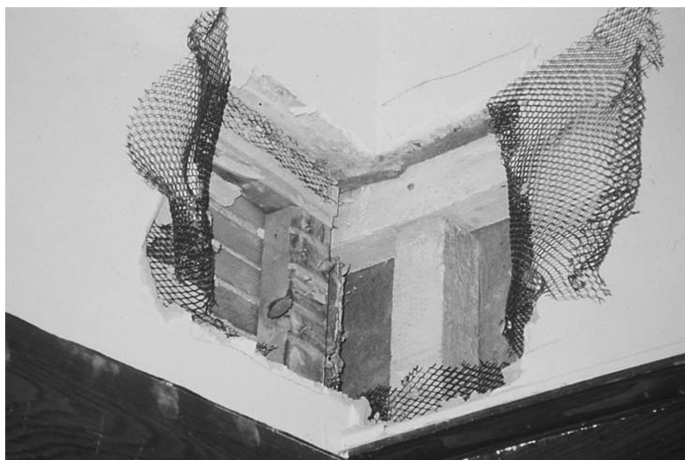


Figure 5. Destructive investigation uncovered original gypsum and wood studs

COLLEGIATE GOTHIC AT YALE

Collegiate Gothic at Yale was introduced considerably later than at Princeton. The first collegiate Gothic building was Memorial Quadrangle, designed by James Gamble Rogers and completed in 1920. This complex is noted for its particular inventory of imagery that depicts the life of the college and the people affiliated with it. Wrexham Tower, which rises over Saybrook Court, was modeled after the tower of St. Giles Court in Wrexham, Wales, where Elihu Yale is buried. Each entryway is named after a distinguished Yale figure. **(fig 6)** More so than Princeton, the buildings at Yale used architecture as a means by which to celebrate the school's culture in built form. Later Yale buildings followed this model to varying degrees, and in general, the growth of the campus during the 1920's and 30's, and the immense amount of work complete there by Rogers, resulted in a very unified architectural fabric.

The decision to incorporate the Collegiate Gothic style was, like at Princeton, tied to a desire to model the university on the perceived qualities of Oxford and Cambridge. In the case of Yale, however, the adoption of the English model was more tied to the specific focus on creating a sense of community. Whereas Princeton's dormitories had a monastic feel and domestic scale, Yale's

adoption of the residential college model allowed its buildings to have a variety of programmatic components (common rooms, dining halls) that helped, to some extent through the varieties of scale, to give the buildings the desired impression of having grown over the years.



Figure 6. Branford courtyard with Wrexham tower

The bulk of Rogers' work at Yale was related to the residential colleges. Three of the initial seven colleges that opened in 1933 were reconstructed from existing Rogers buildings. Memorial Quadrangle, with the addition of dining halls, became Branford and Saybrook Colleges, and the dining hall and master's house wings were completed to transform The Sterling Dormitories (adjacent to Sterling Memorial Library) into Trumbull College.

Architecturally, the Collegiate Gothic style allowed for a variety of compositions and an adaptability and elasticity in the use of stylistic elements. Aaron Betsky described in his book on Rogers, Rogers was "less about making buildings that were derivative of one particular style as ideologically correct way of making architecture than the objective of making elegant, picturesque compositions" (Betsky, p. ix). Rogers was a pragmatist, not an idealist. His work appropriated forms of Modernism as if they were just another part of the historical continuum (Betsky, p. 6). This is likely due in part to the fact that his early design work while in Chicago was on commercial buildings with their emphasis on structure, economy, and the arrangement of the aesthetics to suit the functional needs of the building..

Rogers' Sterling Memorial Library at Yale most clearly exemplifies this 'modern' Gothic style. Completed in 1931, Sterling Memorial Library became the central repository for Yale's extensive

research collections. It was designed to support 3.5 million volumes in a bookstack tower. The steel-framed tower was built using electric arc welding; at the time of its completion it was the largest such welding project ever undertaken. As Paul Goldberger described in his senior thesis:

The bookstack is for all practical purposes a modern skyscraper, sheathed in stone with Gothic detailing, and Rogers placed a great emphasis on its structural characteristics...its 16-story steel frame was welded rather than riveted, standing free as a single unit.

(Goldberger, p. 120)

THE RENOVATION OF TRUMBULL COLLEGE

Trumbull College is currently one of 12 residential colleges at Yale. It consists of five ‘wings’, three of which were constructed in 1929 as the Sterling Dormitories. The remaining wings were completed in 1933 and included the dining hall wing and master’s house wing. The complex currently is approximately 118,000 square feet in size. It houses approximately one half of the 400 students who are called “Trumbullians”, and also provides social and recreational spaces, a dining hall, library, seminar rooms and faculty offices, as well as residences for Faculty Fellows, the Trumbull College Dean and the Trumbull College Master. An early plan shows that at the time of the construction of the dormitory wings it was anticipated that the complex would be completed as a residential college in the future. The phasing of the project was at least in part required by the need to wait for the completion of Yale’s new gymnasium prior to demolition of the old gym. (fig. 7)



Figure 7. Construction photo from June 20, 1930. Sterling Dormitories and the old gymnasium

From the Trumbull College web site:

Trumbull, with about four hundred twenty students, is one of the smaller residential colleges. It is also by far the most picturesque, a granite fortress that looks just the way people think Yale is supposed to look, with "Jacobean" chimneys, "gothic" arches, and a "Norman" dining hall. On Elm Street between York and the Rose Walk, defined on the north by the wall of Sterling Library's most majestic fenestration, we find ourselves in the middle of all the activity that makes Yale Yale.

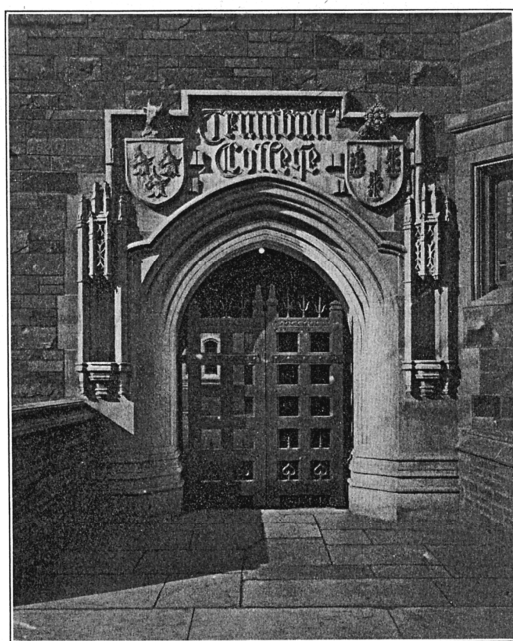
Inside, we're clustered cozily around three courtyards: Main Court, spacious, grassy, and a wonderful echo chamber for the carillon off in Harkness tower; Potty Court, playful, sometimes raucous, indecorously named for its most conspicuous gargoyle who sits on a latrine and gets painted every year by the graduating class; and Stone Court, quieter, serene, austere.

There's a small fourth courtyard at the entrance to the master's house, so photogenic it tends to show up on postcards. James Gamble Rogers, who designed nine of the twelve residential colleges, on its completion in 1930 considered Trumbull--modeled after King's College, Cambridge--his masterpiece. (**fig. 8**)



Figure 8. Courtyard entry to Trumbull master's house

Trumbull is slightly more contemporary in style than the other colleges. Whereas at Memorial Quadrangle Rogers used historical form, in Sterling Memorial Library and in Trumbull Rogers developed a style that has its roots in Gothic but had in it as well an expression of the new methods of construction and a reflection of modern life and ideals (Bergin, p. 148). As a document from August of 1933 explains, “The late afternoon sun reveals the cunning of the sculptor, Lee Lawrie’s ‘restrained and almost flat decoration’ on this Elm Street gateway.” (Yale, p.15) **(fig. 9)** The article further states, “The ingenuity with which all the essentials of a complete college are provided for, without any feeling of crowding, but rather with a feeling of amplitude, has been accentuated by the liberal amount of fenestration in Trumbull College.” This is seen at the main courtyard elevation of wing B, where steel spandrel beams allow for large groupings of decorative windows. **(Fig. 10)**



TRUMBULL COLLEGE—THE LATE AFTERNOON SUN REVEALS THE CUNNING OF THE SCULPTOR, LEE LAWRIE’S “RESTRAINED AND ALMOST FLAT DECORATION” ON THIS ELM STREET GATEWAY. IN THE MODERN SPIRIT OF THE STERLING MEMORIAL LIBRARY, TRUMBULL COLLEGE STANDS ON THE FORMER LOCATION OF THE OLD GYMNASIUM, ON ELM BETWEEN HIGH AND YORK STREETS.

Figure 9. Elm Street entry gate (east) to Trumbull

Programming and design for the renovation project began in May 2003, and construction will be complete in August 2006. Analysis of existing conditions, performed at the start of the project, determined that the exterior walls, Indiana limestone trim throughout with seam face granite ashlar on street fronts and face brick on court walls, are in good condition, as are the steel casement windows. The graduated slate at the roof, along with its gypsum plank substrate, are in good

condition. The scope of work at the exterior includes cleaning of stone only at particularly soiled areas, replacement of some steel windows and most of the leaded glass. Roof work to be done is related to the need to replace copper flashings, etc.



Figure 10. Construction photo, August 1932. Trumbull (center), with Sterling Library at right and Saybrook College at left.

Interior finishes were generally found to be in good condition. One exception has been the veneered plank oak flooring at the main dining hall, which is worn through the veneer and cannot be retained.

As far as reconfiguration goes, in addition to the general scope items identified in the introduction above, the Trumbull project includes the construction of an underground addition under the main courtyard. This addition will house a theater and will also provide space for mechanical equipment in a way that allows for the most direct routing to the various wings of the building.

The architectural and mechanical alterations of the Trumbull College complex require careful review and coordination of these proposed changes with the existing structural systems in the building. In most cases the proposed changes could readily be accommodated by the existing structure. In some instances, however, the proposed changes required alteration or removal and replacement of structural elements. As with the other systems of the building, these renovations required careful review of the existing structure in the building (including conditions, sizes, locations, and capacities of these elements). The details of what was existing and some of the new work associated with the existing structure are described in the following section of this paper.

Integration of Reinforced Concrete and Steel into the Structure

Reinforced Concrete

One of the most interesting structural aspects of each of the various wings at Trumbull College is the way in which they combine unreinforced masonry walls with reinforced concrete elements—in particular, concrete floor slabs. As was common with other late Nineteenth Century and early Twentieth Century structures, the designer of Trumbull College made combinations of reinforced concrete and/ or structural steel with the unreinforced masonry walls that would not be similarly repeated today.

The reinforced concrete floor slabs are often made to span in one direction. In a fairly significant number of areas, however, the builders decided to make use of two-way concrete slabs. These slabs, which have the primary structural steel reinforcing bars spanning in both directions (i.e., to each of the surrounding four sides of the slab) are more complicated to build and somewhat heavier in construction. The advantage is that they can span larger areas without intermediate beams beneath them.

In virtually all instances the load bearing walls support concrete slabs. In areas where the spans were too great to be spanned with a concrete slab of reasonable thickness, the structural designer inserted parallel and regularly spaced steel beams (which span from masonry wall to masonry wall). In cases where the spans were not too large and the floor loads were not too great (i.e., not in areas of public assembly) the designer made use of reinforced concrete beams that are integrally cast with the concrete floor slabs.

We examined the original construction drawings to see if there was any consistency to where square (versus round/ deformed) bars were used. The technology of concrete construction was changing at the time of construction of Trumbull College. The use of square bars was becoming less common and the use of round and/or deformed bars was becoming the standard. Based on these drawings, square bars were used mostly in the footings, slabs, and some beams. In one instance, when we completed probes during construction, we determined that while the original drawings showed round bars were to be used in a column square bars were substituted. We did not see square bars used in any wall construction.

In the concrete footings square bars were used little less than half of the time (if that). In the footings in Wings A and D we observed this mix of square and round bars. The majority of the square footing bars was noted in Wing C; almost all of the footings had square bars in this wing. At Wing C the reinforcing bars in the footings were also noted have “hooked” ends whereas in Wings A and D they were not.

With respect to floor slabs we saw a few instances where square bars were added as additional bars

within the slab to create a small beam at a particular location. The balance of the reinforcing bars used in the floor slabs was all deformed/ round.

Based on a cursory examination of those portions of the building that were exposed during construction, we would say that square reinforcing bars were used in about half of the concrete beams. There was no real consistency to the size of the beam they were used in. The square bars were mostly used as tension steel alone (i.e., continuous bottom bars with “hooked” 90 degree ends); in some instances these square bars were angled for shear reinforcing. The majority of reinforcing steel used on the project was round deformed bars.

The detailing of concrete beams utilized diagonal stirrups (otherwise known as bent up bars) for shear reinforcement. No indications of a Ransome or a catenary placement of reinforcement bars were found at Trumbull College. Steel bars to take shear stresses in beams—such as parallel arrangements of stirrups (as would be used today)—were not used at Trumbull. The Trumbull College construction drawings made use of schedules of reinforced concrete beams and columns; these schedules are very similar to the ones that would still be in use today by a structural engineer. In the case of the column schedule the listed information includes sizes and number of reinforcing bars, cumulative axial loads, elevations, and any types of load transfers.

Unreinforced Concrete

Nearly all of the load bearing foundation walls that extend just one story below grade are made of plain concrete footings and unreinforced masonry (usually stone). If a foundation wall extends more than approximately 12 feet below grade and/ or has significant additional structural loads imposed by adjacent construction (for example, with adjacent footings at higher elevations load from one building is transferred to the lower elevation foundations), the wall is made up of either large mass concrete or reinforced concrete.

Along Elm Street, where lateral loads can be transferred through the entire frame of Building C there are plain concrete buttresses hold back reinforced concrete retaining walls. Along the west side of Wing C (where it is separated from Wing B by less than 15 feet of space), the below grade basement walls of Wing C extend to a lower elevation than those of Wing B. Because of this the foundation walls of Wing C were designed to take the superimposed load from Wing B. This condition is, in fact, noted on the original drawings for Wing C. It is also evident from the structural design shown on the drawings. (**fig. 12**)

The main use of new unreinforced concrete was in the new underpinning that was installed during the current renovation project. This material was placed in each of the existing buildings wherever new construction extended below the elevation of existing foundations. All new underpinning was installed in a staged sequence to minimize the possibility of damage to the existing building elements.

Structural Steel Members

In areas where there were large extents of openings in a façade (such as at bay windows) the Gothic style architecture called for the expression of just stone on the exterior. In reality, the bay windows at Trumbull College are made of structural steel beams that are located immediately behind the exterior masonry.

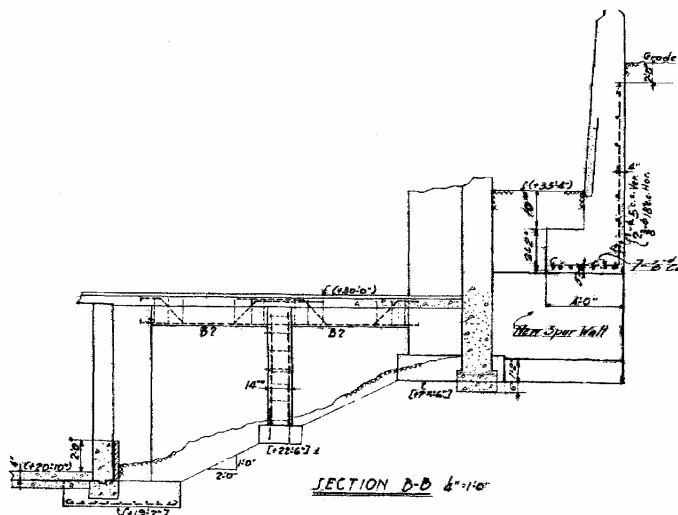


Figure 12. Section at Wing C addition adjacent to Wing B

When water has penetrated this steel (which was not flashed or otherwise waterproofed) the steel has invariably rusted and caused some displacement of the masonry. Fortunately for Yale University, the areas of such deterioration are limited because the amount of such structural steel behind the exterior masonry was very limited in extent.

In all interior locations the structural steel members performed well, were in good condition when we encountered them, and were relatively easy to modify. Indeed, the single largest amount of work that affected the existing structural frames of the residential wings was the introduction of new horizontal circulation hallways on each of the floors in Wings A and B. The creation of these hallways required the removal of various combinations of load-bearing masonry walls, steel beams, and portions of reinforced concrete beams. The insertion of new structural members required the use of significant amounts of temporary shoring and bracing. In general new structural steel members were added to the building and very limited amounts of new cast in place concrete floor slabs were installed.

One of the more noteworthy aspects of the current renovation and addition at Trumbull College is the extensive amount of temporary shoring and bracing that needed to be designed, fabricated,

installed, and (after use) taken down. This temporary shoring and bracing supported both vertical and lateral loads from the construction. Permanent loads are taken by the permanent new structure. In cases where the existing structure was in the way of the new construction or it could not satisfactorily support all of the required loads during construction, temporary shoring and bracing was installed. This required careful coordination between the engineers who designed the shoring/ bracing, the contractors who installed and utilized the shoring/ bracing, and the architects who reviewed the impact of the shoring/ bracing on the permanent building that was to remain after all of the work was complete. There were many areas where historic finishes needed to be protected and the temporary shoring/ bracing had to be made to work around these areas.

Mimicking Historic Gothic Construction with Modern Materials

In addition to the very selective use of structural steel at the exterior walls of Trumbull College, there are also areas where the architect/ engineer designed the building so that stone ribs that appear to be structural (i.e., self supporting) are, in fact, reinforced or supported by structural steel members. There is an instance where, in Wing E, two steel channels were inserted in the floor structure above an arch to attach the stone ribs to the structural steel with Lewis bolts (these bolts or pins attach directly into the rear side of the individual stone rib units). In this way the normal “thrust” from an arch was not transmitted to the adjacent stone window mullions. (fig. 13)

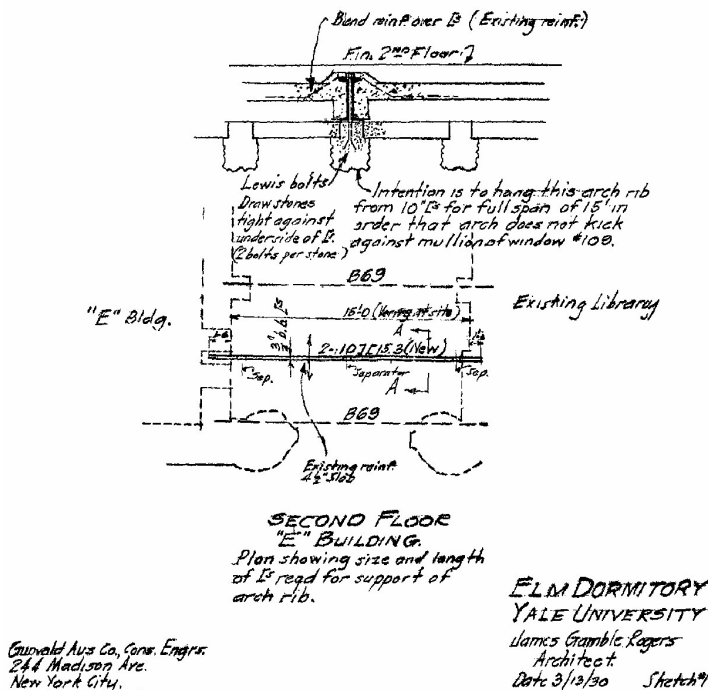


Figure 13. Detail of fake stone rib at Wing E

Traditional Wood Construction Details

In general, structural wood members were not used in the construction of the Trumbull College complex. The main exception is the wood trusses in the roof framing of Wing C for the main dining hall and library spaces. (fig. 14)



Figure 14. Construction of framing for dining hall roof, January, 1933

The trusses in Wing C are composed of heavy timber members and because of this they have significant intrinsic fire resistance. These trusses do contain an iron rod in the vertical wood member (which is labeled as “false” on the drawings), additional steel plates, and additional bolts (especially to transfer shear loads from one member to another). (Fig. 15)

Conclusions Regarding Historic and Modern Structural Systems in Trumbull College

As described above, it is clear that Trumbull College displayed some of the best of the contemporary building materials that were available to the designers and builders of the 1930s. The work was not necessarily leading edge (compare for example, the design and construction of the skyscrapers and large span structures of this time), but it was solid and was done with a careful attention to detail and quality. In most instances the construction details and techniques used at Trumbull were the tried and true. Integrating concrete construction with masonry walls had been done in a large number of other buildings before Trumbull was designed. There are areas where the construction detailing was, perhaps, less successful, such as at the integration of structural steel spandrel beams and exterior stone masonry. For this the designers of Trumbull College cannot be

Hand-drawn structural diagram of a roof truss system. The diagram shows a gabled roof with a central ridge. Key dimensions include a total width of 16'-0" and 17'-0", a ridge height of 19'-0", and a base width of 22'-0". The roof pitch is indicated as 12/12. Various components are labeled, including rafters (6" x 6"), purlins (2" x 8"), and sheathing (1/2" x 6"). The diagram also shows the connection of the roof to the walls, with a 2'-0" overhang on the left and a 3'-0" overhang on the right. The text "ROOF TRUSSES T1&T2" is written below the diagram, along with a note "See Architect's Dwg. 301' for details etc."

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